The Methane-To-Go (CH4-To-Go) field campaign in the Persian/Arabian Gulf – Emissions from off- and on-shore natural gas and oil operations

H. Huntrieser[1], A. Roiger[1], D. Sauer[1], H. Schlager[1] and D. Zavala-Araiza[2]

[1] {Institut für Physik der Atmosphäre, Deutsches Zentrum für Luft- und Raumfahrt (DLR), Oberpfaffenhofen, Germany}
[2] {Climate and Energy, Environmental Defense Fund (EDF), Austin, TX, USA}

The proposed campaign focuses on emissions from the off- and on-shore natural gas and oil operations in the Persian/Arabian Gulf region (~24-27 °N, ~50-56 °E), a wealthy region which contains about 50% of the world´s oil reserves. The flaring, venting and combustion processes produce large amounts of CH_4, a greenhouse gas that is ~25 times more potent than CO_2 and in focus of current mitigation strategies trying to reduce global warming. However, there is a huge lack of detailed CH_4 measurements in the Gulf region and the contribution from this region to the global CH_4 mass balance is presently unknown.

Furthermore, recently a first global satellite-derived SO_2 emissions inventory was established based on measurements with the Ozone Monitoring Instrument (OMI) on the NASA Aura satellite showing a number of SO_2 hot spots in the Persian/Arabian Gulf region. The Middle East region was also highlighted as the region with the most missing SO_2 sources compared to reported sources in the global emission inventories. The petroleum industry operations are mainly responsible for these emissions. In addition, the southern part of the Gulf region is known to be a region with a high density of ship traffic, emitting large but not yet quantified amounts of SO_2, besides the traffic emissions from big cities along the coast as Dubai and Abu Dhabi in the United Arab Emirates (UAE). Worth mentioning is also the high sulphur content in fuels used for vehicles and ships in this region. In recent years the air quality in this region has worsened dramatically.

We plan the performance of airborne in-situ measurements with the German Deutsches Zentrum für Luft- und Raumfahrt (DLR) Falcon-20 in autumn 2019 to probe the isolated, outstanding emission plumes from the different CH_4 and SO_2 sources in the southern part of the Gulf region as mentioned above (aircraft base in Bahrain or in Abu Dhabi, UAE). Besides the DLR-Institute of Atmospheric Physics (IPA) operation of a novel dual Quantum Cascade Laser (QCL) instrument based on laser absorption spectroscopy to measure CH_4 and CO, and related trace gases as CO_2 and C_2H_6 which can be used to distinguish between different CH_4 sources (flaring, venting and combustion), an ion-trap chemical ionization mass spectrometer (IT-CIMS) is foreseen for the measurements of SO_2. Both instruments operate with a high precision/accuracy and a temporal resolution of 0.5 to 1s which covers a horizontal distance of roughly 50-200 m during the flight. Furthermore, measurements of further trace species are foreseen (e.g. NO, NO_y, O_3 and aerosols) and simulations with particle dispersion models for flight planning and post analyses (FLEXPART and HYSPLIT).

The proposed campaign, which is funded by EDF/UNEP and DLR-IPA, includes both survey flights in the southern part of the Gulf region between Bahrain and UAE, as well as single plume study flights focusing on the emissions from single oil and natural gas installations. Furthermore, satellite validation is envisaged with the TROPOMI instrument on Sentinel-5P (focus on CH_4 and SO_2).